ABSTRACT

A method for fabricating an optical resonator on an optical fiber including the steps of generating a differential of a physical property (e.g., diameter, density, refractive index, chemical composition, and so forth) of a transverse segment of the resonator fiber. The resonator fiber segment may substantially confine a circumferential optical mode propagating around the resonator fiber segment circumference at least partially within the resonator fiber segment, thereby enabling substantial confinement of a substantially resonant circumferential optical mode near a surface of the fiber, and enabling evanescent optical coupling between circumferential optical mode and an optical mode supported by a second optical element. Specialized techniques for spatially selectively generating the differential may include masking/etching, masking/deposition, laser machining, laser patterning, combinations thereof, and/or functional equivalents thereof. The circumferential-mode optical resonator may be further provided with one or more alignment structures including flanges and/or grooves for enabling passive positioning of the circumferential-mode optical resonator within an alignment groove of an alignment substrate, and/or for enabling positioning and/or supporting a second optical element. The alignment structures are fabricated at the correct dimensions to enable the optical coupling without extensive active alignment procedures. Structures may also be provided for suppressing undesired optical modes and/or resonances associated with optical resonators and/or alignment structures on the optical fiber. A plurality of resonators positioned on the same fiber sufficiently close together to enable optical coupling between them may be employed to provide a tailored frequency filter function for optically coupling multiple optical elements including optical fibers. A modulator may be provided as an integral component of the circumferential-mode optical resonator, provided directly on the circumferential-mode optical resonator, or provided as a separate assembly positioned on and secured with respect to the alignment substrate. The modulator enables control of the optical properties of the optical resonator, which in turn enables control of the optical power transmitted through the fiber taper segment of the transmission optical fiber.

too long.